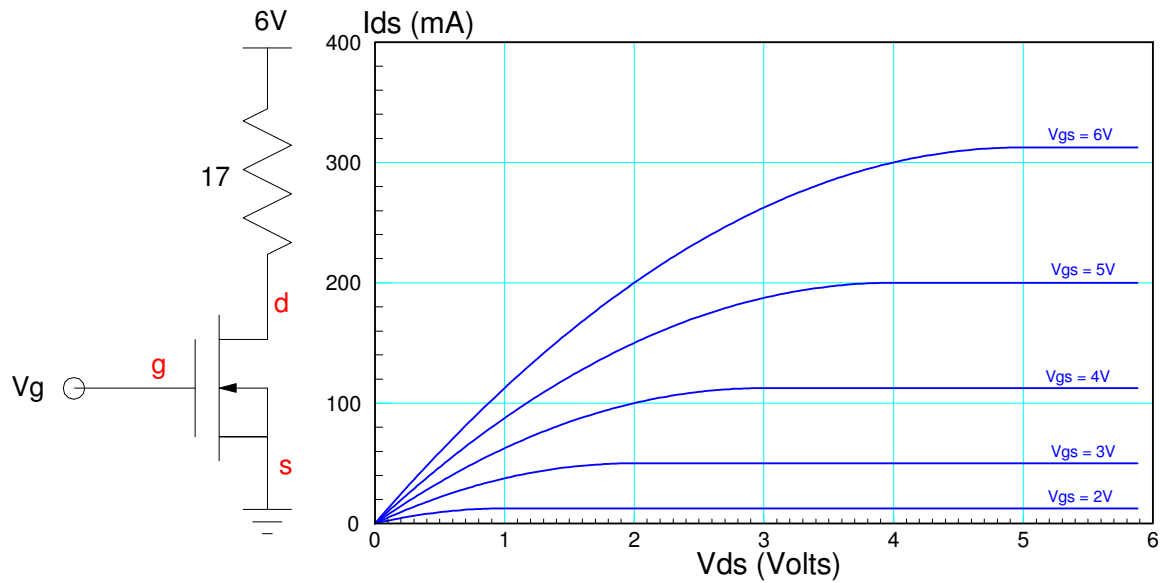


ECE 320: Handout #22

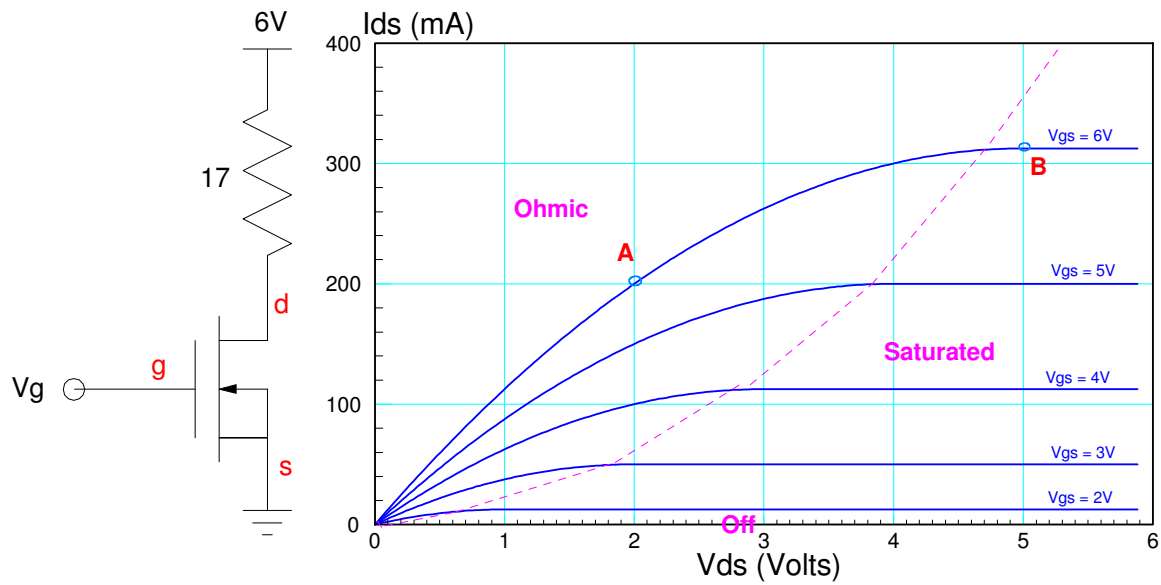
MOSFETs

- 1) Label the off / Saturated / Ohmic regions
- 2) Determine k_n . Assume $V_{tn} = 1.0V$
- 3) Draw the load line for the following circuit
- 4) Determine the Q-point when $V_g = \{ 0V, 4V, 6V \}$



Solution

1) Ohmic / Active / Off regions



2) k_n : Pick a point and compute k_n

Point A) ($V_{ds} = 2.0V$, $V_{gs} = 6.0V$, $I_{ds} = 200mA$)

This is in the ohmic region

$$I_{ds} = k_n \left(V_{gs} - V_{th} - \frac{V_{ds}}{2} \right) V_{ds}$$

$$200mA = k_n \left(6.0V - 1.0V - \frac{2.0V}{2} \right) 2.0V$$

$$k_n = 0.025 \frac{A}{V^2}$$

Point B) ($V_{ds} = 5.0V$, $V_{gs} = 6.0V$, $I_{ds} = 315mA$)

This is in the saturated region

$$I_{ds} = \frac{k_n}{2} (V_{gs} - V_{th})^2$$

$$315mA = \frac{k_n}{2} (6.0 - 1.0)^2$$

$$k_n = 0.0252 \frac{A}{V^2}$$

The two answers should be the same (differences due to errors in reading the graph)

3) Draw the load line for the following circuit

4) Determine the Q-point when $V_g = \{ 0V, 4V, 6V \}$

Y-intercept

$$\left(\frac{6V}{17\Omega} \right) = 352.9mA$$

Q-Points:

$V_g = 0V$:	$V_{ds} = 6.0V$	$I_{ds} = 0mA$	Off
$V_g = 4V$	$V_{ds} = 4.1V$	$I_{ds} = 112mA$	Saturated
$V_g = 6V$	$V_{ds} = 2.3V$	$I_{ds} = 218mA$	Ohmic

